Journal of Advanced Research in Dynamical and Control Systems, 2018, vol.10, N10 Special Issue, pages 1754-1758

Optimization of the parameters of an internal combustion engine using a neural network

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2018, Institute of Advanced Scientific Research, Inc. All rights reserved. The article describes the possibilities of an artificial neural network for optimizing the design and adjusting parameters of a diesel engine in order to reduce the amount of harmful emissions with exhaust gases, describes the methodology for constructing artificial neural networks and their main types. In this paper, we propose an optimization technique based on the teaching of ANN with the use of both experimental and calculated data obtained using the mathematical model of the working process on the basis of a system of differential equations for the energy and mass balances of the working fluid, which significantly reduces the time and material resources development of ICE. Also, a complex mathematical model allows calculations to be made to substantiate the changes introduced to the design of engines for the purpose of their refinement and modernization in order to increase power, economic characteristics and reduce emissions of emissions of explosives (EE) with exhaust gases (EG). The mathematical model of the working process is based on the system of differential equations of the energy balance of the working fluid, which includes dynamic models of the state of the working fluid in the combustion chamber (1), in the intake and exhaust manifolds, the necessary parameters of the turbocharger, cylinder piston group, gas distribution mechanism and fuel equipment.

Keywords

Experimental data, Internal combustion engine, Math modeling, Method of teaching, Neural network, Toxicity of exhaust gases, Working process

References

[1] M. Shah, V. Gaikwad, S. Lokhande, S. Borhade, “Fault identification for I.C. engines using artificial neural network”, Proceedings of 2011 International Conference on Process Automation, Control and Computing, PACC 2011, art. no. 5978891, 2011.

[2] L. Guihang, W. Jian, W. Qiang, S. Jingui, “Application for diesel engine in fault diagnose based on fuzzy neural network and information fusion”, 2011 IEEE 3rd International Conference on Communication Software and Networks, ICCSN 2011, art. no. 6014398, pp. 102-105, 2011.

[3] L.A. Galiullin, R.A. Valiev, “Automation of Diesel Engine Test Procedure”, 2016 2ND International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), 2016.

[4] Y. Yu, J. Yang, “The development of fault diagnosis system for diesel engine based on fuzzy logic”, Proceedings - 2011 8th International Conference on Fuzzy Systems and Knowledge Discovery, FSKD 2011, 1, art. no. 6019556, pp. 472 - 475, 2011.

[5] Y. Shatnawi, M. Al-Khassaweneh, “Fault diagnosis in internal combustion engines using extension neural network”, IEEE Transactions on Industrial Electronics, 61 (3), art. no. 6511979, pp. 1434-1443, 2014.

[6] L.A. Galiullin, “Development of Automated Test System for Diesel Engines Based on Fuzzy Logic”, 2016 2ND International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), 2016.

[7] L.A. Galiullin, R.A. Valiev, L. B. Mingaleeva, “Method of Internal Combustion Engines Testing on The Basis of the Graphic Language”, Journal of Fundamental and Applied Sciences, Vol: 9 pp. 1524-1533, 2017.

[8] N. Deng, C.-S. Jiang, “Fault diagnosis technology based on the fusion of neural network and fuzzy Logic”, 2012 International Conference on Systems and Informatics, pp. 419-422, 2012.

[9] L.A. Galiullin, R.A. Valiev, “Diagnostics Technological Process Modeling for Internal Combustion Engines”, 2017 International Conference on Industrial Engineering, Applications And Manufacturing (ICIEAM), 2017.

[10] X. Li, F. Yu, H. Jin, J. Liu, Z. Li, X. Zhang, “Simulation platform design for diesel engine fault”, 2011 International Conference on Electrical and Control Engineering, ICECE 2011 - Proceedings, art. no. 6057562, pp. 4963 - 4967, 2011.

[11] L.A. Galiullin, R.A. Valiev, “Mathematical Modelling of Diesel Engine Testing and Diagnostic Regimes”, Turkish Online Journal of Design Art and Communication, vol. 7, pp. 1864-1871, 2017.

[12] Z.T. Yao, H.X. Pan, “Engine fault diagnosis based on improved BP neural network with conjugate gradient”, Applied Mechanics and Materials, №536-537, pp. 296-299, 2014.

[13] L.A. Galiullin, R.A. Valiev, L. B. Mingaleeva, “Development of a Neuro-Fuzzy Diagnostic System Mathematical Model for Internal Combustion Engines”, HELIX, Vol. 8, №. 1, pp. 2535-2540, 2018.

[14] D. Wei, “Design of Web based expert system of electronic control engine fault diagnosis”, BMEI 2011 - Proceedings 2011 International Conference on Business Management and Electronic Information, 1, art. no. 5916978, pp. 482 - 485, 2011.

[15] L.A. Galiullin, R.A. Valiev, “Diagnosis System of Internal Combustion Engine Development”, Revista Publicando, 4 No 13(2), pp. 128-137, 2017.

[16] A. N. Iliukhin, Sh. Sh. Khuzyatov, “Modelling of diesel engine's operating conditions on the basis of fuzzy logic”, QUID-Investigacion Ciencia y Tecnologia, Vol. 1(SI). pp. 2557-2563, 2017.

[17] A.N. Iliukhin, R.A. Gibadullin, “Improvement of 'winner takes all' neural network training for the purpose of diesel engine fault clustering”, (2017) 2nd International Conference on Industrial Engineering, Applications and Manufacturing, ICIEAM 2016, Proceedings, art. no. 7911587.